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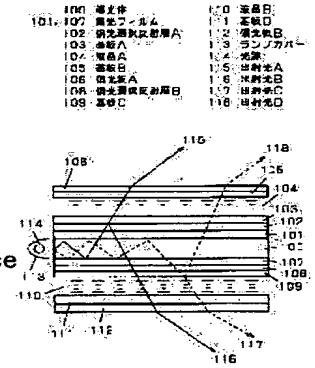
(54) LIQUID CRYSTAL DISPLAY DEVICE AND STEREOSCOPIC DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance luminance of a double-sided display type liquid crystal display device.

SOLUTION: Liquid crystal panels are disposed on both sides of a light guide body and polarized light selecting reflection layers having polarized light selecting properties different from each other are formed between the liquid crystal panels and the light guide body. By this constitution, the polarized light reflected from one polarized light selecting reflection layer can be transmitted through the other liquid crystal panel and the luminance is enhanced.



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CLAIMS

[Claim(s)]
[Claim 1] The liquid crystal display with which the liquid crystal display panel has been arranged to both sides of a transparent material.
[Claim 2] The liquid crystal display according to claim 1 characterized by for one side of said liquid crystal panel being a transflective type liquid crystal display panel, and another side being a transparency mold liquid crystal display panel.
[Claim 3] The liquid crystal display according to claim 1 characterized by for one side of said liquid crystal panel being a reflective mold liquid crystal display panel, and another side being a transparency mold liquid crystal display panel.
[Claim 4] The liquid crystal display according to claim 1 with which the both sides of said liquid crystal panel are characterized by being a transparency mold type liquid crystal display panel.
[Claim 5] The liquid crystal display characterized by having the polarization selectivity from which a polarization selective reflection layer is arranged between said transparent materials and said liquid crystal panels, and said polarization selective reflection layer differs mutually on both sides of said transparent material further in the liquid crystal display with which the liquid crystal panel has been arranged to both sides of a transparent material.
[Claim 6] The 1st liquid crystal layer and the 2nd substrate are formed in the one side side of the 1st substrate, and it sets to the liquid crystal display of said 1st substrate with which the 2nd liquid crystal layer and the 3rd substrate were formed in the side on the other hand. The liquid crystal display which the laminating of the polarization selective reflection layer is carried out between said 1st substrate and said 1st liquid crystal layer, and said 1st substrate and said 2nd liquid crystal layer, and is characterized by having the polarization selectivity from which said polarization selective reflection layer differs mutually on both sides of said 1st substrate further.
[Claim 7] The 1st liquid crystal panel is arranged at one side of a transparent material. Said 1st liquid crystal panel It has the 1st polarization selective reflection layer, the 1st liquid crystal layer, and the 2nd polarization selective reflection layer from said transparent material side. Furthermore, when [of said transparent material] **** 2 liquid crystal panel is arranged on the other hand and said 2nd liquid crystal panel has the 3rd polarization selective reflection layer, the 2nd liquid crystal layer, and the 4th polarization selective reflection layer from said transparent material side It has the polarization selectivity from which said 1st polarization selective reflection layer and said 3rd polarization selective reflection layer differ mutually. The liquid crystal display characterized by having the polarization selectivity from which said 1st polarization selective reflection layer, said 2nd polarization selective reflection layer, and said 3rd polarization selective reflection layer and said 4th polarization selective reflection layer furthermore differ mutually, respectively.
[Claim 8] To the one side side of the 1st substrate, the 1st polarization selective reflection layer from said 1st substrate side, the 1st liquid crystal layer, The 2nd polarization selective reflection layer and the 2nd substrate are formed, and it sets to the liquid crystal display of said 1st substrate with which the 3rd polarization selective reflection layer, the 2nd liquid crystal layer, the 4th polarization selective reflection layer, and the 3rd substrate were formed in the side from said 1st substrate side on the other

hand. It has the polarization selectivity from which said 1st polarization selective reflection layer and said 3rd polarization selective reflection layer differ mutually. The liquid crystal display characterized by having the polarization selectivity from which said 1st polarization selective reflection layer, said 2nd polarization selective reflection layer, and said 3rd polarization selective reflection layer and said 4th polarization selective reflection layer furthermore differ mutually, respectively.

[Claim 9] A liquid crystal display given in either of claims 5-8 to which said polarization selective reflection layer is characterized by having polarization selectivity to the circular polarization of light.

[Claim 10] A liquid crystal display given in either of claims 5-8 to which said polarization selective reflection layer is characterized by having polarization selectivity to the linearly polarized light.

[Claim 11] Claim 5 by which the light source was arranged in the end face of said transparent material, or a liquid crystal display given in seven.

[Claim 12] Claim 5 characterized by preparing the light source in said a part of transparent material, or a liquid crystal display given in seven.

[Claim 13] Claim 6 by which the light source was arranged in the end face of said 1st substrate, or a liquid crystal display given in eight.

[Claim 14] Claim 6 characterized by preparing the light source in said a part of 1st substrate, or a liquid crystal display given in eight.

[Claim 15] The stereoscopic vision display which performs stereoscopic vision in a liquid crystal display given in either of claims 5-8, and a stereoscopic vision display including an optical-path modification device by the display of the both sides of said liquid crystal display displaying a right eye signal and a left eye signal, respectively, and said right eye signal and said left eye signal being compounded by said optical-path modification device.

[Claim 16] The stereoscopic vision display which the display of the both sides of said liquid crystal display displays a right eye signal and a left eye signal, respectively, and performs stereoscopic vision according to said optical-path modification device in a liquid crystal display given in either of claims 5-8, and a stereoscopic vision display including an optical-path modification device because said right eye signal and said left eye signal carry out incidence to a right eye and a left eye separately, respectively.

[Claim 17] The stereoscopic vision display which performs stereoscopic vision because the display of the both sides of said liquid crystal display displays the display information corresponding to the condition that the depth of focuses of an eye differ, respectively and compounds said display information according to said optical-path modification device in a liquid crystal display given in either of claims 5-8, and a stereoscopic vision display including an optical-path modification device.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid crystal display which can realize high brightness by low cost, and a stereoscopic vision display.

[0002]

[Description of the Prior Art] Like paper, the liquid crystal display which can be expressed as both sides stuck the liquid crystal display of two sheets, and was realized.

[0003] On the other hand, the conventional stereoscopic vision display carried out time-sharing actuation of whether the parallel arrangement of the liquid crystal panel of two sheets is carried out, and showed by compounding the information on a right eye and a left eye.

[0004]

[Problem(s) to be Solved by the Invention] When the liquid crystal display of two sheets was stuck and the double-sided display was performed, 2 sets of liquid crystal displays were needed, and low-cost-izing was difficult. Moreover, the technical problem that thickness increased also occurred. Furthermore, the liquid crystal display which can be expressed as both sides uses the polarizing plate of an absorption mold, and was not able to attain low electrification and high brightness-ization.

[0005] the conventional stereoscopic vision indicating equipment using two or more liquid crystal panels on the other hand -- a back light -- the same number -- since it was required, low electrification was difficult. Moreover, the stereoscopic vision display which performs stereoscopic vision by time-sharing actuation had the technical problem to which brightness falls for time-sharing actuation.

[0006]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the following means were provided in the liquid crystal display of a double-sided display mold, and the stereoscopic vision display which used it.

[0007] The 1st liquid crystal display of this invention is characterized by having arranged the liquid crystal display panel to both sides of the transparent material of one sheet. By arranging a liquid crystal display panel to both sides of a transparent material, a transparent material can be managed with one sheet and low cost-ization can be attained. If one side of a liquid crystal panel is used as a transflective type liquid crystal panel and another side is used as a transparency mold liquid crystal panel at this time, it is possible to realize required display grace according to the situation of seeing the screen. For example, in the cellular phone of a folding type, if the front face of a lid is used as a transflective type panel and a rear face is made into a transparency mold panel side, only the transflective type panel excellent in the low power is driven at the time of standby, and a transparency mold panel on the back can be used at the time of the high definition display of a dynamic image etc. Moreover, the liquid crystal display of this invention carries out the laminating of the polarization selective reflection layer between a transparent material and a liquid crystal panel, and is characterized by having the polarization selectivity from which a polarization selective reflection layer differs mutually on both sides of a transparent material further.

[0008] What penetrates a P wave in one side of a transparent material, and reflects an S wave in it as a polarization selective reflection layer is prepared, and what penetrates an S wave to an another side side, and reflects a P wave is prepared. In this case, the reflected light reflected in one polarization selective reflection layer can penetrate the polarization selective reflection layer of another side. Therefore, incidence is efficiently carried out to one of liquid crystal panels, without absorbing back light light, even if it carries out the laminating of the liquid crystal panel to the both sides of a transparent material. For this reason, low electrification and high brightness-ization can be attained. At this time, even if a polarization selective reflection layer has polarization selectivity to the circular polarization of light, the same effectiveness is acquired.

[0009] The 1st liquid crystal layer and the 2nd substrate are formed in the one side side of the 1st substrate which arranged the light source, and the 2nd liquid crystal display of this invention is set to

the liquid crystal display of the 1st substrate with which the 2nd liquid crystal layer and the 3rd substrate were formed in the side on the other hand. The laminating of the polarization selective reflection layer is carried out between the 1st substrate, the 1st liquid crystal layer, and the 1st substrate and the 2nd liquid crystal layer, and it is characterized by having the polarization selectivity from which a polarization selective reflection layer differs mutually on both sides of the 1st substrate further. A light guide function is given to the substrate holding a liquid crystal layer itself, without using a transparent material separately, and thin shape-ization can be attained by attaching a polarization selective reflection layer to a substrate inside, and using it as it further.

[0010] The laminating of the 1st liquid crystal panel is carried out to one side of the transparent material in which the 3rd liquid crystal display of this invention arranged the light source. The 1st liquid crystal panel The 1st polarization selective reflection layer from a transparent material side, the 1st liquid crystal layer, It has the 2nd polarization selective reflection layer. Further and when [of a transparent material] the laminating of the **** 2 liquid crystal panel is carried out on the other hand and the 2nd liquid crystal panel has the 3rd polarization selective reflection layer, the 2nd liquid crystal layer, and the 4th polarization selective reflection layer from a transparent material side It is characterized by having the polarization selectivity from which the 1st polarization selective reflection layer and the 3rd polarization selective reflection layer differ mutually, and having the polarization selectivity from which the 1st polarization selective reflection layer, the 2nd polarization selective reflection layer, and the 3rd polarization selective reflection layer and the 4th polarization selective reflection layer differ mutually further, respectively. By this configuration, the light which carried out incidence to the black display of the 1st liquid crystal panel and the 2nd liquid crystal panel is enabled to carry out incidence to a transparent material again, and efficiency for light utilization improves further.

[0011] The 4th liquid crystal display of this invention to the one side side of the 1st substrate which arranged the light source near the end face from the 1st substrate side The 1st polarization selective reflection layer, the 1st liquid crystal layer, the 2nd polarization selective reflection layer, and the 2nd substrate are formed. In the liquid crystal display of the 1st substrate with which the 3rd polarization selective reflection layer, the 2nd liquid crystal layer, the 4th polarization selective reflection layer, and the 3rd substrate were formed in the side from the 1st substrate side on the other hand It is characterized by having the polarization selectivity from which the 1st polarization selective reflection layer and the 3rd polarization selective reflection layer differ mutually, and having the polarization selectivity from which the 1st polarization selective reflection layer, the 2nd polarization selective reflection layer, and the 3rd polarization selective reflection layer and the 4th polarization selective reflection layer differ mutually further, respectively. Efficiency for light utilization improves by the same reason as the 3rd liquid crystal display by this configuration.

[0012] In any of a liquid crystal display given in eight they are, and a stereoscopic vision display including an optical-path modification device, the display of the both sides of said liquid crystal display displays a right eye signal and a left eye signal, respectively from claim 5, and the 1st stereoscopic vision display of this invention is characterized by performing stereoscopic vision by a right eye signal and a left eye signal being compounded by the optical-path modification device. Stereoscopic vision becomes possible by using each of a double-sided display for the signal of a right eye and a left eye.

[0013] In any of a liquid crystal display given in eight they are, and a stereoscopic vision display including an optical-path modification device, the display of the both sides of a liquid crystal display displays a right eye signal and a left eye signal, respectively from claim 5, and the 2nd stereoscopic vision display of this invention is characterized by performing stereoscopic vision according to an optical-path modification device, because a right eye signal and a left eye signal carry out incidence to a right eye and a left eye separately, respectively.

[0014] Stereoscopic vision is acquired even if a signal carries out incidence to a right eye and a left eye according to an individual.

[0015] The 3rd stereoscopic vision display of this invention is characterized by the display of the both

sides of a liquid crystal display performing stereoscopic vision by displaying the display information corresponding to the condition that the depth of focuses of an eye differ, respectively, and compounding display information according to an optical-path modification device in any of a liquid crystal display given in eight they are from claim 5, and a stereoscopic vision display including an optical-path modification device. Stereoscopic vision is acquired even if it piles up the display information corresponding to the condition that the depth of focuses of an eye differ.

[0016]

[Embodiment of the Invention] The liquid crystal display of the gestalten 1-4 of the following operations is a liquid crystal display which has a display on both sides of a substrate.

[0017] (Gestalt 1 of operation) Drawing 2 is principle drawing showing that efficiency for light utilization improves with the liquid crystal display of this invention. In drawing 2 , if the light source light 203 which carried out outgoing radiation by no polarizing from the light source 207 carries out incidence to the polarization selective reflection layer A201, although S wave 205 of the linearly polarized light penetrates the polarization selective reflection layer A201, as for P wave 204, it will reflect it. Incidence of reflected P wave 204 is carried out to the polarization selective reflection layer B202. If it is the configuration that the polarization selective reflection layer B202 penetrates a P wave, and reflects an S wave at this time, the reflected light from the polarization selective reflection layer A201 will penetrate the polarization selective reflection layer B202. For this reason, the light source light 203 will penetrate either the polarization selective reflection layer A201 or the polarization selective reflection layer B202 theoretically. For this reason, compared with the case where the conventional absorption mold polarization layer is used, efficiency for light utilization improves substantially. In addition, the selectivity of polarization may have selectivity to the left-handed circularly-polarized light and the right-handed circularly polarized light besides a P wave and an S wave. The same effectiveness will be acquired if polarization selectivity differs mutually in the polarization selective reflection layer A201 and the polarization selective reflection layer B202.

[0018] Drawing 1 is the sectional view of the 1st liquid crystal display of this invention. After being condensed in the direction of a normal with the condensing film 101, incidence of a part of light which carried out outgoing radiation of the light source 114 is carried out to the polarization selective reflection layer A102. The polarization selective reflection layer A102 has the configuration which reflects a P wave and penetrates an S wave. For this reason, an S wave penetrates liquid crystal A104, and it carries out outgoing radiation from a substrate B105 (outgoing radiation light A115). On the other hand, it reflects in the polarization selective reflection layer A102, and incidence of the P wave is carried out to the polarization selective reflection layer B108. The polarization selective reflection layer B108 has the configuration which penetrates a P wave and reflects an S wave. For this reason, the reflected light (P wave) from the polarization selective reflection layer A102 penetrates the polarization selective reflection layer B108, and it carries out outgoing radiation from a substrate D111 (outgoing radiation light B116).

[0019] On the other hand, a P wave consists of the light source with the outgoing radiation light C117 by the principle with the same said of the light which carried out incidence to the polarization selective reflection layer B108, and an S wave changes with the outgoing radiation light D118. For this reason, the light of the light source changes to outgoing radiation being carried out from either a substrate B105 or the substrate D111, without being absorbed, and its efficiency for light utilization improves.

[0020] As a polarization selective reflection layer of a P wave and an S wave, D-BEF (3 M company make) can be used, for example. Moreover, the polarization selectivity over the circular polarization of light may be used, for example, a cholesteric-liquid-crystal polymer component etc. can be used.

[0021] Moreover, by using a condensing film, light source light is condensed in the direction of a normal, and polarization selectivity improves. There is a dependency in the polarization selectivity of a polarization selective reflection layer whenever [incident angle], and the direction of a normal of this is because polarization selectivity is the highest.

[0022] Although the above is the configuration of the liquid crystal display of a transparency mold, this may have opening in a part of pixel, or the configuration of the transflective LCD using the diffusion shell is sufficient as it. Moreover, a transflective type inserted the transparent material while is sufficient as another side in a transparency mold.
[0023] Moreover, a reflective mold panel is sufficient as another side for one side of the liquid crystal panel arranged on both sides of a transparent material by the transparency mold liquid crystal panel or the transflective type panel. In this case, although a double-sided display cannot be performed, when observing the screen from one side, a reflective mold display and a transparency mold (or transflective type) display can be changed if needed. For this reason, it can respond to a low power with a reflective mold, can respond to a high definition display and the object with a transparency mold, and can use properly.
[0024] (Gestalt 2 of operation) Drawing 3 shows the sectional view of the 2nd liquid crystal display of this invention. A polarization selective reflection layer and a liquid crystal layer are formed in the both sides of a substrate A300, and the light source 311 is embedded at the edge of a substrate A300. The substrate A300 is making the maintenance function of liquid crystal, and the function of a transparent material serve a double purpose. At this time, the transparent material shown in the gestalt 1 of operation becomes unnecessary, and thin shape-ization can be attained.
[0025] Minute concavo-convex structure may be prepared in the front face of a substrate A300 so that light source light may carry out the light guide of the inside of a substrate to homogeneity. As concavo-convex structure, magnitude and distribution density can be changed timely and a groove, the shape of a dot, and the concavo-convex structure of semicircle pillar-shaped ** can be used so that the brightness within a field may become uniform.
[0026] (Gestalt 3 of operation) Drawing 4 shows the sectional view of the 3rd liquid crystal display of this invention. In the same configuration as the gestalt 1 of operation, the polarization selective reflection layer C412 was formed in the outside of a substrate C421 on the outside of the polarization selective reflection layer D422 and a substrate D411. Moreover, the polarization selective reflection layer A402 and the polarization selective reflection layer B408 have different polarization selective reflection nature. Furthermore, it has the polarization selective reflection nature from which the polarization selective reflection layer A402, the polarization selective reflection layer D422, and the polarization selective reflection layer B408 and the polarization selective reflection layer C412 also differ. The polarization selective reflection layer A402 and the polarization selective reflection layer C412 penetrate an S wave, and, specifically, reflect a P wave. Moreover, the polarization selective reflection layer D422 and the polarization selective reflection layer B408 penetrate a P wave, and reflect an S wave. Moreover, let liquid crystal A404 and liquid crystal B410 be the display modes which a phase does not become irregular to the light which passes a liquid crystal layer at the time of a black display, but perform a phase modulation at the time of a white display. It is reflected in a transparent material side and the light source light which carried out incidence to the liquid crystal layer of the location equivalent to the black display of a panel by this configuration consists that it is possible to carry out outgoing radiation of the white display of a liquid crystal layer located in the opposite hand of a transparent material. For this reason, efficiency for light utilization improves further.
[0027] The light which carried out incidence to the black display 405 among the S waves which penetrated the polarization selective reflection layer A402 does not receive a phase modulation in a liquid crystal layer. For this reason, incidence is carried out to the polarization selective reflection layer D422 with an S wave, it is reflected in a transparent material side and outgoing radiation is carried out from the white display 413 of an opposite hand. Moreover, in order that the light which carried out incidence to the white display 406 may receive a phase modulation (S wave -> P wave) with liquid crystal A404, outgoing radiation of it is carried out from a substrate C421 side (outgoing radiation light B418).
[0028] In the case of normally black mode, the homogeneous orientation driven by horizontal electric

field and vertical orientation mode can be used for the display mode of a liquid crystal layer. Moreover, it is twisted, and in the case of nematic orientation, if it uses by the normally white mode, polarization selectivity with it will be acquired at the time of a black display. [a small phase modulation and] [good]

[0029] (Gestalt 4 of operation) Drawing 5 is the sectional view of the 4th liquid crystal display of this invention. With the almost same configuration as the gestalt 2 of operation, the polarization selective reflection layer D508 was formed in the outside of a substrate B503 on the outside of the polarization selective reflection layer B504 and a substrate C507. Moreover, the polarization selective reflection layer A501 and the polarization selective reflection layer C505 have different polarization selective reflection nature. Furthermore, it has the polarization selective reflection nature from which the polarization selective reflection layer A501, the polarization selective reflection layer B504, and the polarization selective reflection layer C505 and the polarization selective reflection layer D508 also differ. The polarization selective reflection layer A501 and the polarization selective reflection layer D508 penetrate an S wave, and, specifically, reflect a P wave. Moreover, the polarization selective reflection layer C505 and the polarization selective reflection layer B504 penetrate a P wave, and reflect an S wave.

[0030] Moreover, let liquid crystal A502 and liquid crystal B506 be the display modes which a phase does not become irregular to the light which passes a liquid crystal layer at the time of a black display, but perform a phase modulation at the time of a white display. By this configuration, efficiency for light utilization improves by the same principle as the gestalt 3 of operation.

[0031] The liquid crystal display of the gestalten 5 and 6 of the following operations is a liquid crystal display which has a display in one side of a substrate.

[0032] (Gestalt 5 of operation) Drawing 6 is the block diagram of the 1st stereoscopic vision display of this invention. The liquid crystal display of gestalt 1 publication of operation with which the laminating of a liquid crystal panel A901 and the liquid crystal panel B902 was carried out to the transparent material 900 is arranged. The screen is met and the reflecting plate A904, the reflecting plate B905, the optical element A906, and the optical element B907 are arranged as an optical-path modification device. The optical element has the function which irradiates the signal of the screen on a screen 908 at homogeneity. Moreover, as for a liquid crystal display, the double-sided screen displays a right eye signal and a left eye signal, respectively. According to the above-mentioned optical-path modification device, the stereoscopic vision of a signal becomes possible by being compounded on a screen 908.

[0033] It should just be used for a liquid crystal display from the operation gestalt 1 any of a liquid crystal display given in four they are. Moreover, an optical-path modification device can be formed so that a right eye signal and a left eye signal can be compounded on a screen besides the above.

[0034] (Gestalt 6 of operation) Drawing 7 is the block diagram of the 2nd stereoscopic vision display of this invention. The liquid crystal display of gestalt 1 publication of the operation which consists of a transparent material 800, a liquid crystal panel A801, and liquid crystal panel B802 grade is arranged. Moreover, the optical-path modification device which consists of a reflecting plate A803 and a reflecting plate B804 is formed. At this time, the display of the both sides of a liquid crystal display displays a right eye signal and a left eye signal, respectively, and a right eye signal and a left eye signal become possible [performing stereoscopic vision] according to an optical-path modification device by considering as the configuration which carries out incidence to a right eye and a left eye separately, respectively.

[0035] (Gestalt 7 of operation) The 3rd stereoscopic vision display of this invention displays the display information corresponding to the condition that the depth of focuses of an eye differ [the display of the both sides of a liquid crystal display], respectively, in the same configuration as the gestalt 5 of operation. If the image with which the depth of focuses of an eye differ is compounded, it will become possible to perform stereoscopic vision.

[0036]

[Effect of the Invention] As mentioned above, according to this invention, the efficiency for light

utilization of the liquid crystal display of a double-sided display or an one side display improves, and raise in brightness and low electrification can be attained. Moreover, thin shape-ization can be attained by giving a transparent material function to a substrate.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The sectional view of the liquid crystal display of the gestalt 1 of operation
[Drawing 2] Principle drawing of improvement in efficiency for light utilization
[Drawing 3] The sectional view of the liquid crystal display of the gestalt 2 of operation
[Drawing 4] The sectional view of the liquid crystal display of the gestalt 3 of operation
[Drawing 5] The sectional view of the liquid crystal display of the gestalt 4 of operation
[Drawing 6] The block diagram of the stereoscopic vision display of the gestalt 5 of operation
[Drawing 7] The block diagram of the stereoscopic vision display of the gestalt 6 of operation
[Description of Notations]
100 Transparent Material
101 Condensing Film
102 Polarization Selective Reflection Layer A
103 Substrate A
104 Liquid Crystal A
105 Substrate B
106 Polarizing Plate A
107 Condensing Film
108 Polarization Selective Reflection Layer B
109 Substrate C
110 Liquid Crystal B
111 Substrate D
112 Polarizing Plate B
113 Lamp Cover
114 Light Source
115 Outgoing Radiation Light A
116 Outgoing Radiation Light B
117 Outgoing Radiation Light C
118 Outgoing Radiation Light D

[Translation done.]

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27/26		27/26		２Ｈ０８９
Ｇ０２Ｆ　1/13	５０５	Ｇ０２Ｆ　1/13	５０５	２Ｈ０９１
1/1335	５１０	1/1335	５１０	５Ｃ０６１

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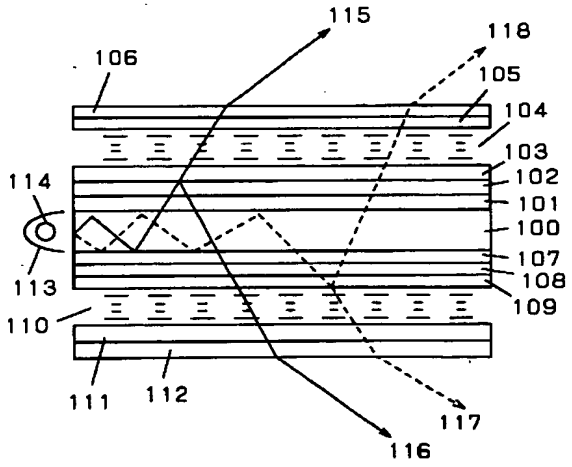
(54)【発明の名称】　液晶表示装置、及び立体視表示装置

(57)【要約】
【課題】　両面表示型の液晶表示装置の輝度の向上を図る。
【解決手段】　導光体を挟んで両側に液晶パネルを配置し、液晶パネルと導光体間に互いに偏光選択性が異なる偏光選択反射層を形成する。本構成により、一方の偏光選択反射層で反射した偏光が他方の液晶パネルを透過することが可能となり輝度が向上する。

100　導光体
101，107　集光フィルム
102　偏光選択反射層Ａ
103　基板Ａ
104　液晶Ａ
105　基板Ｂ
106　偏光板Ａ
108　偏光選択反射層Ｂ
109　基板Ｃ
110　液晶Ｂ
111　基板Ｄ
112　偏光板Ｂ
113　ランプカバー
114　光源
115　出射光Ａ
116　出射光Ｂ
117　出射光Ｃ
118　出射光Ｄ



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【特許請求の範囲】

【請求項１】導光体の両面に液晶表示パネルが配置された液晶表示装置。

【請求項２】前記液晶パネルの一方が、半透過型液晶表示パネルであり、他方が透過型液晶表示パネルであることを特徴とする請求項１記載の液晶表示装置。

【請求項３】前記液晶パネルの一方が、反射型液晶表示パネルであり、他方が透過型液晶表示パネルであることを特徴とする請求項１記載の液晶表示装置。

【請求項４】前記液晶パネルの双方が、透過型型液晶表示パネルであることを特徴とする請求項１記載の液晶表示装置。

【請求項５】導光体の両面に液晶パネルが配置された液晶表示装置において、前記導光体と前記液晶パネル間に偏光選択反射層が配置され、さらに前記導光体の両側で前記偏光選択反射層が互いに異なる偏光選択性を有することを特徴とする液晶表示装置。

【請求項６】第１基板の片面側に第１液晶層と第２基板が形成され、前記第１基板の他面側に第２液晶層と第３基板が形成された液晶表示装置において、前記第１基板と前記第１液晶層、及び前記第１基板と前記第２液晶層間に偏光選択反射層が積層され、さらに前記第１基板の両側で前記偏光選択反射層が互いに異なる偏光選択性を有することを特徴とする液晶表示装置。

【請求項７】導光体の片面に第１液晶パネルが配置され、前記第１液晶パネルが、前記導光体側から第１偏光選択反射層、第１液晶層、及び第２偏光選択反射層を有し、さらに前記導光体の他面に第２液晶パネルが配置され、前記第２液晶パネルが、前記導光体側から第３偏光選択反射層、第２液晶層、及び第４偏光選択反射層を有するときに、前記第１偏光選択反射層と前記第３偏光選択反射層が互いに異なる偏光選択性を有し、さらに前記第１偏光選択反射層と前記第２偏光選択反射層、及び前記第３偏光選択反射層と前記第４偏光選択反射層がそれぞれ互いに異なる偏光選択性を有することを特徴とする液晶表示装置。

【請求項８】第１基板の片面側に前記第１基板側から、第１偏光選択反射層、第１液晶層、第２偏光選択反射層、及び第２基板が形成され、前記第１基板の他面側に前記第１基板側から第３偏光選択反射層、第２液晶層、第４偏光選択反射層、及び第３基板が形成された液晶表示装置において、前記第１偏光選択反射層と前記第３偏光選択反射層が互いに異なる偏光選択性を有し、さらに前記第１偏光選択反射層と前記第２偏光選択反射層、及び前記第３偏光選択反射層と前記第４偏光選択反射層がそれぞれ互いに異なる偏光選択性を有することを特徴とする液晶表示装置。

【請求項９】前記偏光選択反射層が、円偏光に対して偏光選択性を有することを特徴とする請求項５から８のいずれかに記載の液晶表示装置。

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【請求項１０】前記偏光選択反射層が、直線偏光に対して偏光選択性を有することを特徴とする請求項５から８のいずれかに記載の液晶表示装置。

【請求項１１】前記導光体の端面に光源が配設された請求項５、又は７記載の液晶表示装置。

【請求項１２】前記導光体の一部に光源が設けられたことを特徴とする請求項５、又は７記載の液晶表示装置。

【請求項１３】前記第１基板の端面に光源が配設された請求項６、又は８記載の液晶表示装置。

【請求項１４】前記第１基板の一部に光源が設けられたことを特徴とする請求項６、又は８記載の液晶表示装置。

【請求項１５】請求項５から８のいずれかに記載の液晶表示装置と光路変更機構を含む立体視表示装置において、前記液晶表示装置の両側の表示部がそれぞれ右目信号と左目信号を表示し、前記光路変更機構により、前記右目信号と前記左目信号が合成されることで立体視を行う立体視表示装置。

【請求項１６】請求項５から８のいずれかに記載の液晶表示装置と光路変更機構を含む立体視表示装置において、前記液晶表示装置の両側の表示部がそれぞれ右目信号と左目信号を表示し、前記光路変更機構により、前記右目信号と前記左目信号が別個にそれぞれ右目と左目に入射することで立体視を行う立体視表示装置。

【請求項１７】請求項５から８のいずれかに記載の液晶表示装置と光路変更機構を含む立体視表示装置において、前記液晶表示装置の両側の表示部がそれぞれ目の焦点深度が異なる状態に対応する表示情報を表示し、前記光路変更機構により前記表示情報を合成することで立体視を行う立体視表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、低コストで高輝度が実現できる液晶表示装置、及び立体視表示装置に関する。

【０００２】

【従来の技術】紙のように両面で表示可能な液晶表示装置は、２枚の液晶表示装置を貼り合わせて実現されていた。

【０００３】一方、従来の立体視表示装置は、２枚の液晶パネルを並列配置するか時分割駆動し、右目と左目の情報を合成して表示を行っていた。

【０００４】

【発明が解決しようとする課題】２枚の液晶表示装置を貼り合わせて両面表示を行うと２組の液晶表示装置が必要となり、低コスト化が困難であった。また、厚みが増加するという課題もあった。さらに、両面で表示可能な液晶表示装置は吸収型の偏光板を用いており、低電力化と高輝度化が図れなかった。

【０００５】一方、複数の液晶パネルを用いる従来の立

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体視表示装置は、バックライトも同数必要なため低電力化が困難であった。また、時分割駆動で立体視を行う立体視表示装置は時分割駆動のため輝度が低下する課題があった。

【０００６】

【課題を解決するための手段】上記課題を解決するために、両面表示型の液晶表示装置、及びそれを用いた立体視表示装置において、以下の手段を講じた。

【０００７】本発明の第１の液晶表示装置は、１枚の導光体の両面に液晶表示パネルを配置したことを特徴とする。導光体の両面に液晶表示パネルを配置することで、導光体が１枚で済み低コスト化が図れる。このとき、液晶パネルの一方を半透過型液晶パネルとし、他方を透過型液晶パネルとすると、表示面を見る状況により、必要な表示品位を実現することが可能である。例えば、折りたたみ式の携帯電話において、蓋の表面を半透過型パネルとし、裏面を透過型パネルの側とすると、待機時は低消費電力に優れた半透過型パネルのみ駆動し、動画像等の高品位表示時は裏面の透過型パネルを使用することができる。また、本発明の液晶表示装置は、導光体と液晶パネル間に偏光選択反射層を積層し、さらに導光体の両側で偏光選択反射層が互いに異なる偏光選択性を有することを特徴とする。

【０００８】偏光選択反射層として、例えば導光体の片側にＰ波を透過しＳ波を反射するものを設け、他方の側にはＳ波を透過しＰ波を反射するものを設ける。この場合、一方の偏光選択反射層で反射した反射光は他方の偏光選択反射層を透過することが可能である。従って導光体の両側に液晶パネルを積層してもバックライト光が吸収されることなく効率的にどちらかの液晶パネルに入射される。このため低電力化と高輝度化が図れる。このとき、偏光選択反射層は、円偏光に対して偏光選択性を有しても同様の効果が得られる。

【０００９】本発明の第２の液晶表示装置は、光源を配設した第１基板の片面側に第１液晶層と第２基板が形成され、第１基板の他面側に第２液晶層と第３基板が形成された液晶表示装置において、第１基板と第１液晶層、及び第１基板と第２液晶層間に偏光選択反射層が積層され、さらに第１基板の両側で偏光選択反射層が互いに異なる偏光選択性を有することを特徴とする。導光体を別途用いずに、液晶層を保持する基板自体に導光機能を持たせ、さらに偏光選択反射層を基板に内付けすることで薄型化が図れる。

【００１０】本発明の第３の液晶表示装置は、光源を配設した導光体の片面に第１液晶パネルが積層され、第１液晶パネルが、導光体側から第１偏光選択反射層、第１液晶層、及び第２偏光選択反射層を有し、さらに導光体の他面に第２液晶パネルが積層され、第２液晶パネルが、導光体側から第３偏光選択反射層、第２液晶層、及び第４偏光選択反射層を有するときに、第１偏光選択反射層と第３偏光選択反射層が互いに異なる偏光選択性を有し、さらに第１偏光選択反射層と第２偏光選択反射層、及び第３偏光選択反射層と第４偏光選択反射層がそれぞれ互いに異なる偏光選択性を有することを特徴とする。本構成により、第１液晶パネル、及び第２液晶パネルの黒表示部に入射した光が導光体に再度入射することが可能となり、光利用効率がさらに向上する。

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【００１１】本発明の第４の液晶表示装置は、端面付近に光源を配設した第１基板の片面側に第１基板側から、第１偏光選択反射層、第１液晶層、第２偏光選択反射層、及び第２基板が形成され、第１基板の他面側に第１基板側から第３偏光選択反射層、第２液晶層、第４偏光選択反射層、及び第３基板が形成された液晶表示装置において、第１偏光選択反射層と第３偏光選択反射層が互いに異なる偏光選択性を有し、さらに第１偏光選択反射層と第２偏光選択反射層、及び第３偏光選択反射層と第４偏光選択反射層がそれぞれ互いに異なる偏光選択性を有することを特徴とする。本構成により第３の液晶表示装置と同様の理由で光利用効率が向上する。

【００１２】本発明の第１の立体視表示装置は、請求項５から８記載の液晶表示装置の何れかと光路変更機構を含む立体視表示装置において、前記液晶表示装置の両側の表示部がそれぞれ右目信号と左目信号を表示し、光路変更機構により、右目信号と左目信号が合成されることで立体視を行うことを特徴とする。両面表示のそれぞれを右目と左目の信号に用いることで立体視が可能となる。

【００１３】本発明の第２の立体視表示装置は、請求項５から８記載の液晶表示装置の何れかと光路変更機構を含む立体視表示装置において、液晶表示装置の両側の表示部がそれぞれ右目信号と左目信号を表示し、光路変更機構により、右目信号と左目信号が別個にそれぞれ右目と左目に入射することで立体視を行うことを特徴とする。

【００１４】信号が右目と左目に個別に入射しても立体視が得られる。

【００１５】本発明の第３の立体視表示装置は、請求項５から８記載の液晶表示装置の何れかと光路変更機構を含む立体視表示装置において、液晶表示装置の両側の表示部がそれぞれ目の焦点深度が異なる状態に対応する表示情報を表示し、光路変更機構により表示情報を合成することで立体視を行うことを特徴とする。目の焦点深度が異なる状態に対応する表示情報を重ねても立体視が得られる。

【００１６】

【発明の実施の形態】以下の実施の形態１から４の液晶表示装置は、基板の両側に表示部を有する液晶表示装置である。

【００１７】（実施の形態１）図２は本発明の液晶表示装置で光利用効率が向上することを示す原理図である。

図２において、光源２０７から無偏光で出射した光源光２０３が、偏光選択反射層Ａ２０１に入射すると、偏光選択反射層Ａ２０１を直線偏光のＳ波２０５は透過するがＰ波２０４は反射する。反射したＰ波２０４は偏光選択反射層Ｂ２０２に入射する。このとき、偏光選択反射層Ｂ２０２がＰ波を透過しＳ波を反射する構成であれば、偏光選択反射層Ａ２０１からの反射光は偏光選択反射層Ｂ２０２を透過する。このため原理的に光源光２０３は偏光選択反射層Ａ２０１、または偏光選択反射層Ｂ２０２のどちらかを透過することになる。このため、従来の吸収型偏光層を用いる場合に比べ光利用効率が大幅に向上する。なお、偏光の選択性はＰ波とＳ波以外にも左円偏光と右円偏光に対して選択性を有しても良い。偏光選択反射層Ａ２０１と偏光選択反射層Ｂ２０２で偏光選択性が互いに異なれば、同様の効果が得られる。

【００１８】図１は本発明の第１の液晶表示装置の断面図である。光源１１４を出射した光の一部は、集光フィルム１０１で法線方向に集光された後、偏光選択反射層Ａ１０２に入射する。偏光選択反射層Ａ１０２は、Ｐ波を反射しＳ波を透過する構成を有している。このため、Ｓ波は液晶Ａ１０４を透過し、基板Ｂ１０５から出射する（出射光Ａ１１５）。一方、Ｐ波は偏光選択反射層Ａ１０２で反射して、偏光選択反射層Ｂ１０８に入射する。偏光選択反射層Ｂ１０８はＰ波を透過しＳ波を反射する構成を有している。このため、偏光選択反射層Ａ１０２からの反射光（Ｐ波）は偏光選択反射層Ｂ１０８を透過し、基板Ｄ１１１から出射する（出射光Ｂ１１６）。

【００１９】一方、光源から偏光選択反射層Ｂ１０８に入射した光も同様の原理で、Ｐ波は出射光Ｃ１１７と成り、Ｓ波は出射光Ｄ１１８と成る。このため光源の光は吸収されること無く基板Ｂ１０５、又は基板Ｄ１１１の一方から出射されることに成り、光利用効率が向上する。

【００２０】Ｐ波とＳ波の偏光選択反射層としては、例えばＤ－ＢＥＦ（３M社製）を用いることができる。また、円偏光に対する偏光選択性を利用しても良く、例えばコレステリック液晶ポリマー素子等を用いることができる。

【００２１】また、集光フィルムを用いることで、光源光が法線方向に集光され偏光選択性が向上する。これは、偏光選択反射層の偏光選択性には入射角度依存性があり、法線方向が最も偏光選択性が高いためである。

【００２２】上記は透過型の液晶表示装置の構成であるが、これは画素の一部に開口を有するか、半透過膜を用いた半透過型液晶表示装置の構成でも良い。また、導光体を挟んだ一方が透過型で他方が半透過型でも良い。

【００２３】また、導光体を挟んで配置された液晶パネルの一方が透過型液晶パネルか半透過型パネルで、他方が反射型パネルでも良い。この場合、両面表示は出来ないが、片側から表示面を観察する場合に、必要に応じて反射型表示と透過型（又は半透過型）表示を切り替えることができる。このため反射型で低消費電力、透過型で高品位表示と目的に応じて使い分けが可能である。

【００２４】（実施の形態２）図３は本発明の第２の液晶表示装置の断面図を示す。基板Ａ３００の両側に偏光選択反射層と液晶層を形成し、基板Ａ３００の端部に光源３１１が埋め込まれている。基板Ａ３００は液晶の保持機能と導光体の機能を兼用している。このとき、実施の形態１に示した導光体が不要となり薄型化が図れる。

【００２５】基板Ａ３００の表面には、光源光が基板内を均一に導光するように微小な凹凸構造を設けても良い。凹凸構造としては、溝状、ドット状、または半円柱状等の凹凸構造を、面内輝度が均一となるように大きさと分布密度を適時変えて用いることができる。

【００２６】（実施の形態３）図４は本発明の第３の液晶表示装置の断面図を示す。実施の形態１と同様の構成において、基板Ｃ４２１の外側に偏光選択反射層Ｄ４２２、基板Ｄ４１１の外側に偏光選択反射層Ｃ４１２を形成した。また、偏光選択反射層Ａ４０２と偏光選択反射層Ｂ４０８は異なる偏光選択反射性を有する。さらに、偏光選択反射層Ａ４０２と偏光選択反射層Ｄ４２２、及び偏光選択反射層Ｂ４０８と偏光選択反射層Ｃ４１２も異なる偏光選択反射性を有する。具体的には、偏光選択反射層Ａ４０２と偏光選択反射層Ｃ４１２は、Ｓ波を透過してＰ波を反射する。また、偏光選択反射層Ｄ４２２と偏光選択反射層Ｂ４０８は、Ｐ波を透過してＳ波を反射する。また、液晶Ａ４０４、液晶Ｂ４１０は黒表示時に液晶層を通過する光に対して位相が変調せず白表示時に位相変調を行う表示モードとする。本構成により、パネルの黒表示部に相当する位置の液晶層に入射した光源光は導光体側に反射され、導光体の反対側に位置する液晶層の白表示部から出射することが可能と成る。このため、光利用効率がさらに向上する。

【００２７】偏光選択反射層Ａ４０２を透過したＳ波のうち、黒表示部４０５に入射した光は、液晶層で位相変調を受けない。このため偏光選択反射層Ｄ４２２にＳ波のまま入射し、導光体側に反射されて反対側の白表示部４１３から出射する。また、白表示部４０６に入射した光は液晶Ａ４０４で位相変調（Ｓ波→Ｐ波）を受けるため基板Ｃ４２１側から出射する（出射光Ｂ４１８）。

【００２８】液晶層の表示モードには、ノーマリブラックモードの場合は横電界で駆動するホモジニアス配向や、垂直配向モードを用いることができる。また、捻れネマチック配向の場合は、ノーマリホワイトモードで用いると黒表示時に位相変調が小さく良好な偏光選択性が得られる。

【００２９】（実施の形態４）図５は本発明の第４の液晶表示装置の断面図である。実施の形態２とほぼ同様の構成で、基板Ｂ５０３の外側に偏光選択反射層Ｂ５０

４、基板Ｃ５０７の外側に偏光選択反射層Ｄ５０８を形成した。また、偏光選択反射層Ａ５０１と偏光選択反射層Ｃ５０５は異なる偏光選択反射性を有する。さらに、偏光選択反射層Ａ５０１と偏光選択反射層Ｂ５０４、及び偏光選択反射層Ｃ５０５と偏光選択反射層Ｄ５０８も異なる偏光選択反射性を有する。具体的には、偏光選択反射層Ａ５０１と偏光選択反射層Ｄ５０８は、Ｓ波を透過してＰ波を反射する。また、偏光選択反射層Ｃ５０５と偏光選択反射層Ｂ５０４は、Ｐ波を透過してＳ波を反射する。

【００３０】また、液晶Ａ５０２、液晶Ｂ５０６は黒表示時に液晶層を通過する光に対して位相が変調せず白表示時に位相変調を行う表示モードとする。本構成により、実施の形態３と同様の原理で光利用効率が向上する。

【００３１】以下の実施の形態５、及び６の液晶表示装置は基板の片側に表示部を有する液晶表示装置である。

【００３２】（実施の形態５）図６は本発明の第１の立体視表示装置の構成図である。導光体９００に液晶パネルＡ９０１と液晶パネルＢ９０２が積層された実施の形態１記載の液晶表示装置が配置されている。表示面に対面して、光路変更機構として反射板Ａ９０４、反射板Ｂ９０５、光学素子Ａ９０６、及び光学素子Ｂ９０７が配置されている。光学素子は、表示面の信号をスクリーン９０８上に均一に照射する機能を有している。また、液晶表示装置は両面の表示面がそれぞれ右目信号と左目信号を表示する。信号は上記の光路変更機構により、スクリーン９０８上で合成されることで立体視が可能となる。

【００３３】液晶表示装置は、実施形態１から４記載の液晶表示装置の何れかを用いれば良い。また、光路変更機構は上記以外にもスクリーン上で右目信号と左目信号が合成できるように形成できる。

【００３４】（実施の形態６）図７は本発明の第２の立体視表示装置の構成図である。導光体８００、液晶パネルＡ８０１、及び液晶パネルＢ８０２等から成る実施の形態１記載の液晶表示装置が配置されている。また、反射板Ａ８０３、及び反射板Ｂ８０４から成る光路変更機構が形成されている。このとき、液晶表示装置の両側の表示部がそれぞれ右目信号と左目信号を表示し、光路変更機構により、右目信号と左目信号が別個にそれぞれ右目と左目に入射する構成とすることで、立体視を行うことが可能となる。

【００３５】（実施の形態７）本発明の第３の立体視表示装置は、実施の形態５と同様の構成において、液晶表示装置の両側の表示部が、それぞれ目の焦点深度が異なる状態に対応する表示情報を表示する。目の焦点深度が異なる画像を合成すると立体視を行うことが可能となる。

【００３６】

【発明の効果】以上、本発明によれば、両面表示、又は片面表示の液晶表示装置の光利用効率が向上し高輝度化と低電力化が図れる。また、基板に導光体機能を付与することで、薄型化が図れる。

【図面の簡単な説明】

【図１】実施の形態１の液晶表示装置の断面図

【図２】光利用効率の向上の原理図

【図３】実施の形態２の液晶表示装置の断面図

【図４】実施の形態３の液晶表示装置の断面図

【図５】実施の形態４の液晶表示装置の断面図

【図６】実施の形態５の立体視表示装置の構成図

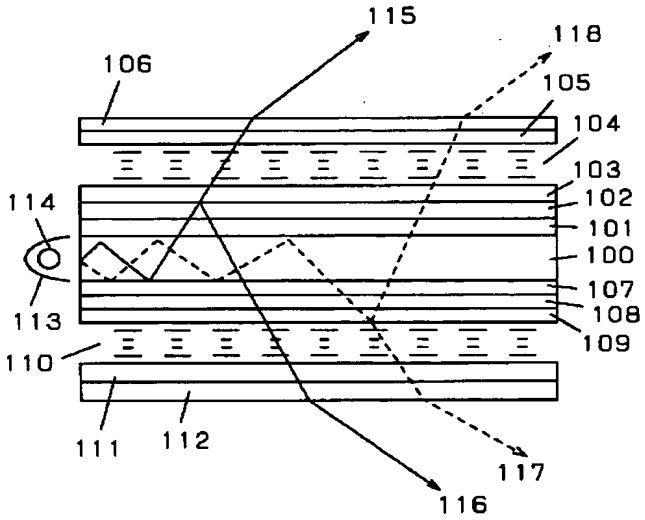
【図７】実施の形態６の立体視表示装置の構成図

【符号の説明】

１００　導光体
１０１　集光フィルム
１０２　偏光選択反射層Ａ
１０３　基板Ａ
１０４　液晶Ａ
１０５　基板Ｂ
１０６　偏光板Ａ
１０７　集光フィルム
１０８　偏光選択反射層Ｂ
１０９　基板Ｃ
１１０　液晶Ｂ
１１１　基板Ｄ
１１２　偏光板Ｂ
１１３　ランプカバー
１１４　光源
１１５　出射光Ａ
１１６　出射光Ｂ
１１７　出射光Ｃ
１１８　出射光Ｄ

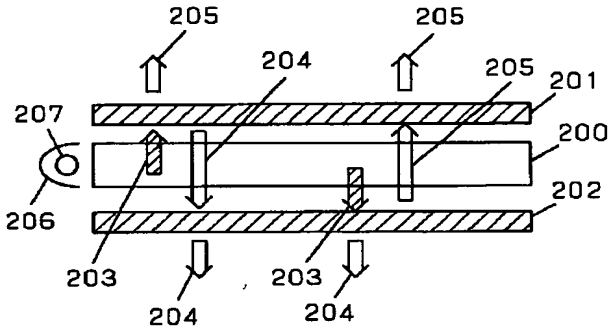
【図１】

100 導光体
101, 107 集光フィルム
102 偏光選択反射層A
103 基板A
104 液晶A
105 基板B
106 偏光板A
108 偏光選択反射層B
109 基板C
110 液晶B
111 基板D
112 偏光板B
113 ランプカバー
114 光源
115 出射光A
116 出射光B
117 出射光C
118 出射光D



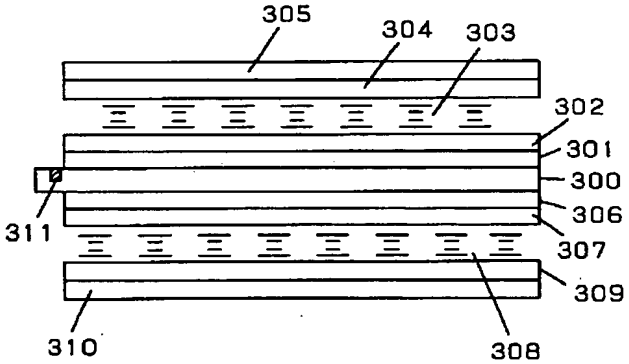
【図２】

200 導光体
201 偏光選択反射層A
202 偏光選択反射層B
203 光源光
204 P波
205 S波
206 ランプカバー
207 光源



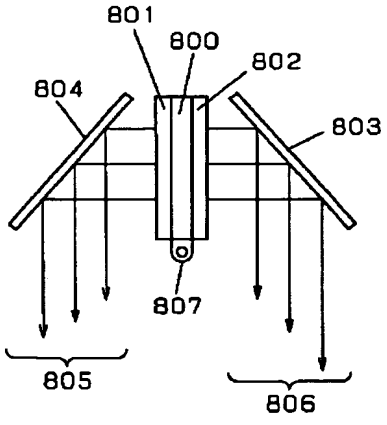
【図３】

300 基板A
301 集光フィルムA
302 偏光選択反射層A
303 液晶層A
304 基板B
305 偏光板A
306 集光フィルムB
307 偏光選択反射層B
308 液晶層B
309 基板C
310 偏光板B
311 光源



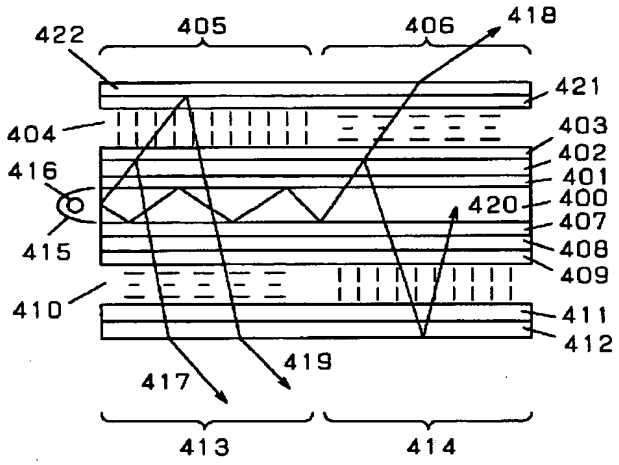
【図７】

800 導光体
801 液晶パネルA
802 液晶パネルB
803 反射板A
804 反射板B
805 左目信号
806 右目信号
807 光源



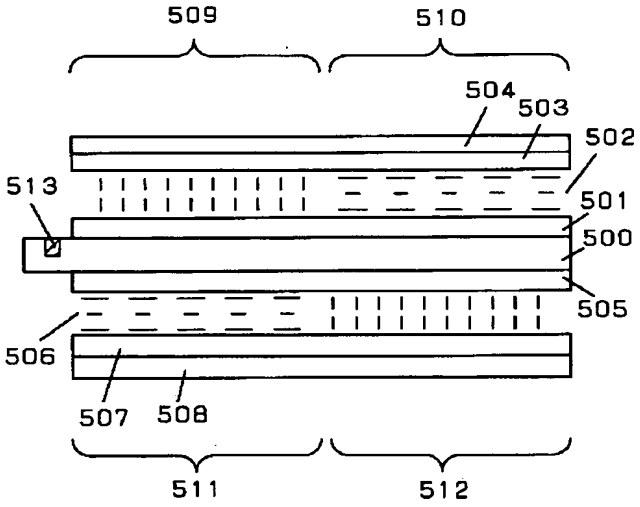
【図４】

400 導光体
401 集光フィルム
402 偏光選択反射層A
403 基板A
404 液晶A
405, 414 黒表示部
406, 413 白表示部
407 集光フィルム
408 偏光選択反射層B
409 基板C
410 液晶B
411 基板D
412 偏光選択反射層C
415 ランプカバー
416 光源
417 出射光A
418 出射光B
419 出射光C
420 反射光A
421 基板C
422 偏光選択反射層D



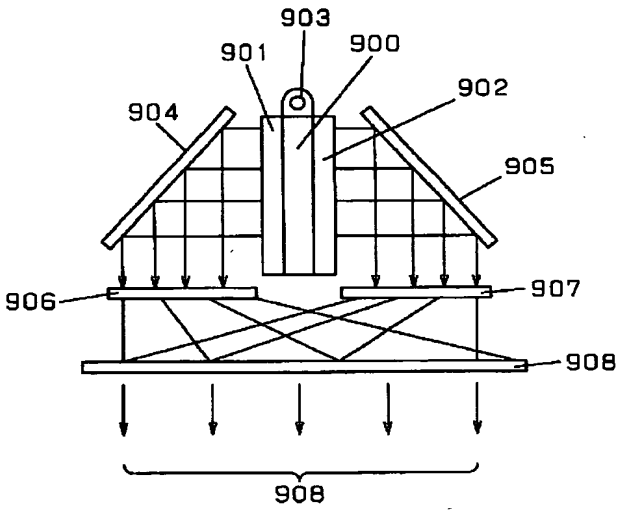
【図５】

500 基板A
501 偏光選択反射層A
502 液晶A
503 基板B
504 偏光選択反射層B
505 偏光選択反射層C
506 液晶B
507 基板C
508 偏光選択反射層D
509, 512 黒表示部
510, 511 白表示部
513 光源



【図６】

900 導光体
901 液晶パネルA
902 液晶パネルB
903 光源
904 反射板A
905 反射板B
906 光学素子A
907 光学素子B
908 スクリーン



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